Effect of season on serum enzymes in Punganur cattle

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Abstract

Punganur cattle is a miniature breed that was evolved to endure low rainfall and draught conditions of the native climatic conditions of Chittoor district of Andhra Pradesh. This breed thrives on nominal feed with reasonable milk production. Scanty studies were conducted in this breed and there was a lack in establishment of base physio-biochemical values in this breed and also there were almost no studies on the changes in the physio-biochemical activities in these cattle in different seasons. In this context, the present study was designed to present the base levels of serum enzymes in this breed and to see the effect of seasons on serum enzymes in Punganur cattle. Sixty apparently healthy Punganur cattle [Females (n=30) and Males (n=30)] that were aged above 2 years were maintained separately at Livestock Research Station, Palamaner of Sri Venkateswara Veterinary University. Serum AST, ALT, ALP and GGT enzyme concentrations during different seasons in these cattle were studied and compared. As a result of the present study, establishment of base level serum enzyme values could be achieved in both the sexes of the Punganur breed across the seasons. Also a comparative effect of different seasons on the serum enzymes in both sexes of the breed was studied which shows significantly ($P<0.05$) elevated levels of AST, ALT and ALP in summer in either of the sexes with no alteration in serum GGT among different seasons in them.

Keywords: Punganur, cattle, serum enzymes, seasons, base line values, climatic stress.

Introduction

India is one of the mega bio diversified nations that is home for large diversified cattle genetic resources. Diversified indigenous cattle breeds are essentially the consequence of the adaptation process to the varied climatic conditions with enhanced adaptation to endure diseases of tropical climate and centuries of domestication (Srivastava *et al.,* 2019.). One such diversified cattle breed of southern part of India is Punganur. Punganur cattle breed is humped dwarf cattle breed originating from Chittoor district of Andhra Pradesh (Vinod *et al.,* 2019 & 2024). Punganur is a dual purpose breed which was evolved over time to meet the harsh native climatic conditions like low rainfall and frequent draught which enable the animal to thrive on minimal inputs with relatively better milk production. Punganur cattle is at the verge of extinction and there is dearth of information on the physiological and biochemical parameters of the breed (Naik *et al.,* 2013). Physiological characterization of the breed involves establishing reference values for hematology, cardiovascular and blood chemistry parameters in both the sexes during different seasons (Naik *et al.,* 2013).

Seasonal variations, which include temperature and humidity, particularly, pose effect on animal biology and are considered as stressors (Mazzullo *et al*., 2014). Criteria like animal physiology, welfare, health, reproduction *etc.,* thereby livestock production are influenced by the effect of climate (Gauly and Ammer, 2020). Sudden outbreaks of certain vector borne diseases in livestock are very much possible with the advent of increasing temperatures combined with changes in humidity and rainfall (Haile, 2020). Cattle present different adaptive characteristics and seasonal dynamics to handle the changing climatic conditions (De Vasconcelos *et, al*., 2020). Serum biochemical values such as serum enzyme concentrations, provide reference line evidence that help to evaluate the management practices, physiological and nutritional status of the animals and also help to assess the health condition of the animal (De *et al*., 2021). Blood enzyme picture undergoes seasonal variation in response to various environmental factors. Blood profile is an important indicator for diagnosis, treatment, and prognosis of diseases (Giri *et al.,*2017). The serum enzyme data reported by various workers from various countries in different breeds from their native climates cannot be considered as reference value for the same in Punganur breed in its native climate. Hence there is need to evaluate the breed in its native environment for its serum enzymes to deduce the reference values of serum enzymes in Punganur breed over all the seasons. Due to dearth of data with regards to the base line data in terms of serum enzymes in Punganur cattle, the present study was designed to profile serum enzymes data for Punganur cattle and also to compare the same over different seasons.

Materials and Methods

The present investigation was carried out on Punganur cattle (Figure 1) maintained at Livestock Research Station of Sri Venkateswara Veterinary University situated at Palamaner, Chittoor district, Andhra Pradesh (Latitude: 13.2081° N and Longitude: 78.7845° E), which is located at the natural habitat of the breed. Blood collection was done in three different seasons *viz.,* Summer (May), Monsoon (September) and Winter (November).

Figure 1: Punganur cattle

Grouping of the cattle

A total of sixty (60) apparently healthy Punganur cattle aged 2 years and above were selected for the present study. The animals were grouped as: Females (n=30) and Males (n=30).

Temperature Humidity Index (THI)

Microclimatic data *viz.,* dry and wet bulb temperatures, minimum and maximum temperatures and relative humidity was recorded daily throughout the study period.

Blood sample collection, transport and storage:

Blood was collected in clot activator vacutainer (BD tubes). Immediately after collection, the samples were labeled and transported to the laboratory on ice. Samples were allowed to clot for two hours. Serum was separated and stored in -20℃ deep freezer until further analysis.

Estimation of serum enzymes

The Aspartate aminotransferase (AST) and Alanine aminotransferase (ALT) were estimated in the serum samples by Modified IFCC methods using Erba diagnostic kits as per the manufacturer's protocol (Tietz, 1982) and (Tietz, 1994), respectively. Alkaline phosphatase (ALP) activities were estimated by IFCC Kinetic method (Burtis and Ashwood, 1999) by Erba kit and γ- Glutamyl transferase (GGT) concentration was estimated by Carboxy substrate method as per the manufacturer's protocol using Coral diagnostic kit.

The obtained experimental data for different seasons from Punganur cattle (male, female, total herd) has been tabulated properly and analyzed for finding significance as per the procedures of (Snedecor and Cochran, 1994) by using statistical package for social sciences (SPSS-25 software).

Results and Discussion

The present research was performed with an aim to compare the effect of different seasons *viz*., summer, monsoon, and winter on serum enzymes AST, ALT, Alkaline phosphatase, GGT in male, female and total herd in Punganur cattle.

Environmental temperature along with relative humidity plays a major role in intensifying the heat stress which is proven to be detrimental to physiological status of the animals. Temperature humidity index (THI) is the best, easiest and practical index to measure the level of heat stress in dairy cattle (Grewal *et al.,* 2021).

During this experiment, the climatic conditions were measured continuously. In the present study, the mean THI values were observed to be significantly ($P<0.05$) higher during summer (79.03±1.22) than monsoon (70.93±1.17) and winter (69.25±1.26) seasons. The workers *viz*., (Alameen and Abdelatif, 2012) and (Tej *et al.,* 2017) recorded higher THI values during summer season. THI of 72 and below was considered as lack of heat stress, with physiological changes occurrence after THI 74 though no drastic changes appear from THI 74 to 79 but once THI crosses above 80 the homeostasis will be lost (Jeelani *et al.,* 2019). Our findings suggest that the summer season was having moderate heat stress when compared with works from previous studies by various workers. In the current study, monsoon and winter were devoid of heat stress, as suggested by the findings of (Hasan *et al.*, 2026), who reported that a THI value of 70 or less, comfortable and 70 as a threshold.

Serum enzyme activities

The mean values of enzyme activity of AST (IU/L), ALT (IU/L) and ALP (IU/L) during different seasons in males, females and Total herd of Punganur cattle are presented in Table-1.

Table-1: The mean values of enzyme activity of AST (IU/L), ALT (IU/L) and ALP (IU/L) during different seasons in males, females and Total herd of Punganur cattle

Serum Enzymes	Sex	Season		
		Summer (Mean ± SE)	Monsoon (Mean ± SE)	Winter (Mean ± SE)
AST (IU/L)	Males (n=30)	114.10±3.24^{a}	108.92±2.93^{ab}	104.42±1.21^{b}
	Females (n=30)	116.53±2.73^{a}	110.49±2.35^{ab}	106.81±2.88^{b}
	Total Herd (n=60)	115.32±2.10^{a}	109.70±1.86^{ab}	105.61±1.56^{b}
ALT (IU/L)	Males (n=30)	29.99±0.72^{a}	28.64±0.90^{ab}	26.89±0.69^{b}
	Females (n=30)	30.03 ± 0.47^{a}	28.41±0.63^{ab}	27.74±0.62^{b}
	Total Herd(n=60)	30.01±0.43^{a}	28.53±0.55^{ab}	27.32±0.46^{b}
ALP (IU/L)	Males (n=30)	122.15±2.82^{a}	116.14±2.85^{ab}	110.62±2.53^{b}
	Females (n=30)	118.62±3.20^{a}	112.57±2.29^{ab}	108.66±2.05^{b}
	Total Herd(n=60)	120.39±2.13^{a}	114.36±1.83^{ab}	109.64±1.62^{b}

$P<0.05$: Significant; means with similar superscripts with in a row do not differ significantly

Serum AST

In the present study, in males, the activity of AST (IU/L) enzyme were significantly ($P<0.05$) higher in summer (114.10±3.24) compared to winter. In females, the activity of AST (IU/L) enzyme were significantly ($P<0.05$) higher in summer (116.53±2.73) compared to winter and in total herd of Punganur cattle, the activity of AST (IU/L) enzyme were significantly ($P<0.05$) higher in summer (115.32±2.10) compared to winter.

The present findings of the serum AST levels were higher in summers which were in approval with the findings of (Valencia *et al.,* 2026) who reported that the average AST (U/l) activities were higher during summer

compared to winter in Holstein heifers. Similar findings were reported by (Chabanenko and Shynkarenko, 2025) in Brown Swiss dairy cows and (Martínez *et al.,* 2026) in transition dairy cows, where the mean AST (U/l) levels were significantly higher in summer than winter seasons in transition dairy cows.

Serum ALT

In male cattle, there was significant (P<0.05) higher enzyme activity of ALT (IU/L) in summer (29.99±0.72) compared to winter, in females, enzyme activity of ALT (IU/L) were significantly (P<0.05) higher in summer (30.03 ± 0.47) compared to winter and the ALT (IU/L) activity in total herd of Punganur cattle showed significantly (P<0.05) higher values in summer (30.01±0.43) compared to winter.

The Punganur cattle of this study showed significant (P<0.05) higher enzyme activity of ALT (IU/L) in summer compared to winter. Our study was in acceptance with (Chabanenko and Shynkarenko, 2025) who recorded that the mean ALT (U/l) levels were significantly higher in summer than winter seasons in Brown Swiss dairy cows and attributed the same to disorders in the energy metabolism. Though the present study showed significant difference in the values of ALT across seasons, all the values were in normal range.

Serum ALP

In the present study, in male cattle, the mean values of ALP activity were significantly (P<0.05) higher in summer (122.15±2.82) compared to winter. In Punganur female cattle, the means of ALP activity showed significantly (P<0.05) higher value in summer (118.62±3.20) compared to winter. The ALP (IU/L) activity in total herd of Punganur cattle showed significantly (P<0.05) higher values in summer (120.39±2.13) compared to winter.

In our study, in Punganur cattle the mean values of ALP activity were significantly (P<0.05) higher in summer compared to winter. Alkaline phosphatase is involved in maintaining homeostasis and energy generation in animal body and that seems to be the reason of higher activity. The current study results in ALP were also in acceptance with the findings of (Giri *et al*., 2017) who recorded that the mean ALP (IU/l) levels were higher during summer than winter seasons in dairy cows in high altitude cold desert.

Serum GGT

In the present study, Punganur cattle, could not show significant (P>0.05) difference in the enzyme activity of GGT between summer, monsoon and winter, with GGT activity of 15.41±0.57 in monsoon, 15.81±0.55 in winter and 16.85±0.56 in summer in males; 15.68±0.75, 16.27±0.67 and 16.92± 0.53 in monsoon, winter and summer, respectively in females; 15.55±0.47, 16.04±0.43 and 16.88±0.38 in monsoon, winter and summer, respectively in total herd.

In contrast to the present study results, (Mazzullo *et al*., 2014) reported that significantly higher GGT (U/l) levels were noticed in spring season than in winter, summer and autumn seasons in Piemontese cows of Italy and attributed the rise to the production stress on lactating cows.

Conclusion

Environmental variations during different seasons may impact blood indices in livestock. Punganur is a dual-purpose miniature cattle breed of Andhra Pradesh which was evolved over time to meet the native climatic conditions. There is a need to establish a reference baseline for the serum enzymes in Punganur breed in different seasons. This present study tried to establish the same. When studied the serum enzymes in the Punganur cattle through various seasons, the activity of AST, ALT and ALP enzymes were significantly higher in summer in all the groups compared to winter. GGT value showed no significant change among all the groups between different seasons.

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